# SSCI 588 – Remote Sensing for GIS
# Course Syllabus – Spring Semester 2014

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**Office Hours:** (tentative) Monday – Friday 8 am to 12 pm Pacific Time. I am always available asynchronously via email. Also, available for synchronous chats via phone or Skype or Adobe Connect, audio or video most days and times *by prior arrangement* via email. Just get in touch!

### *Course Scope and Purpose*

This course is an elective course for both the GIST Graduate Certificate and Master of Science degree programs and explores some of the ways in which remote sensing systems provide geospatial information that is relevant, accurate, timely, accessible, available in an appropriate format, and cost-effective. Recent developments in Earth observation such as imaging radar, LiDAR and hyperspectral sensors are increasing the wealth of information that can be generated from remotely sensed data sources. As a consequence numerous new GIS applications, that rely on advanced remotely sensed data sources, have emerged at local, regional and global scales. We will cover several topics:

*Remote Sensing Principles* – We start by examining the history and modern-day scope of remote sensing and continue with an in-depth review of the full electromagnetic spectrum since the interpretation of remote sensing imagery depends first and foremost, on a sound understanding of electromagnetic radiation and its interaction with the surfaces and atmosphere.

*Image Acquisition* – Here we examine the fundamentals involved in image acquisition, by examining a variety of topics associated with digital photographic sensor systems, the role and importance of digital data, the typical steps that would be involved in transforming these digital data into information (i.e. image interpretation), the various Earth observation missions launched thus far, various contributions provided by microwave, LiDAR, thermal sensor systems, and the role of image resolution in projects integrating remote sensing and GIS.

*Image Analysis* – We next take up the typical remote sensing for GIS workflow that starts with one or more forms of preprocessing (i.e. radiometric, geometric corrections, and feature extraction), continues with the process of assigning pixels to classes using one or more forms of digital image classification, and typically concludes with the collection and use of field data for model calibration and accuracy assessment. We will also examine hyperspectral remote sensing, which utilizes many of the aforementioned principles and methods, but requires specialized data sets, instruments, field data and software.

*GIS / Remote Sensing Applications* – We will conclude the course by looking at the various ways in which GIS and remote sensing have been integrated and used to characterize vegetation (i.e. land use/land cover), geologic, geomorphic, soil and hydrologic phenomena at a variety of scales ranging from individual land parcels and neighborhoods to first cities, regions, continents, hemispheres and nowadays, to the entire globe.

### *Learning Outcomes*

When you have completed this course, you will be able to:

- Explain the principles of remote sensing and the technical characteristics and constraints of Earth Observation missions
- Design, implement and critically evaluate methods of digital image processing ranging from preprocessing to image classification, field data collection and accuracy assessment
- Generate geographical information by processing digital remotely sensed data and critically evaluate its use for environmental applications
- Critically evaluate the opportunities and available methods for integrating remote sensing and GIS.

### *Course Formats*

This is a graduate level course, so you should expect this class to be both academically robust and intellectually challenging. As graduate students you are expected to engage with the information you are learning and to explore the heady cauldron of ideas, opinion, and analysis that describe our collective effort to thoroughly interrogate the subject at hand. Learning arises from active engagement with the knowledge found in our reading materials and with one another. As in any graduate-level class, the instructor's role is that of a guide who keeps you on this path of discovery and you will find that you will learn much from your fellow classmates. The challenge for us is to replicate such an academic experience within the milieu of "online learning".

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through course notes and assigned readings and the assignments will give students an opportunity to internalize and apply the concepts and theory learned from readings. Some assignments require students interaction, all will benefit from it.

We have several technologies that will facilitate our course work and our interactions, despite our dispersed locations. These include:

*Blackboard* – All course materials and correspondence will be posted on the course Blackboard site. As a registered student you'll find this course will show up in your available courses at noon Pacific Time on the first day of classes. It is here that the day-to-day flow of the course will be recorded.

*Discussion boards and Blogs* – On the Blackboard site, we'll post a number of discussion threads relevant to various sections of the course. I may or may not participate in these threads but they are vitally important when we get to some of the "hands-on" work as we expect students to work "together" on these exercises, sharing hints and help as you would do in a common laboratory classroom. Additional discussion threads may be used to organize asynchronous discussions.

*Live meetings and presentations* - At USC, we use a browser-based service called Adobe Connect to create synchronous interaction sessions. With voice and webcam capabilities Adobe Connect can be used to share presentations and even our desktops between two or more people.

*Individual meetings* - While Adobe Connect can be used for one-on-one meetings, we generally find it's easier to use the free VOIP and chat technology, Skype (http://www.skype.com) for individual chats.

### *Assessment*

Your grade in this class will be determined on the basis of several different assessment tools:

*Reading Assignments – 9 for a total of 27 points.* These will focus on the theory portion of the course as presented in the weekly readings. Their objective is to help you evaluate and integrate the information you have acquired from the course readings. Some of these will involve discussions and collaborative work and some will be individual efforts. These are graded on an absolute point scale (3 per assignment, breakdown of points varies by assignment). Late assignments will be docked one point. No grade will be given for assignments turned in over one week late.

*IDRISI® Selva Assignments – 9 for a total of 27 points.* These will be scheduled throughout the semester and will require you to work through individual chapters of the Warner and Campagna (2009) workbook during the weeks they are assigned. To demonstrate that you have completed each chapter, you will turn in a quick copy of some digital output or brief text answers from the final part of the exercise such as a .jpg of the map produced at the final step. These are graded on a credit/no credit basis, and no credit given for late assignments. NOTE: Even though the book's title says "Remote Sensing with IDRISI Taiga", all the tutorials in this book work well with the new version of IDRISI (IDRISI Selva) we have on our GIST online server.

*Exercises – 3 for a total of 12 points.* In order to demonstrate that you understand the basic concepts and skills learned in the class, you will complete four exercises that will integrate key concepts and ideas and take some independent thought.

*Presentation – 1 for a total of 10 points.* This assignment will require some independent thought and synthesis and allow you to explore a case study of your choice that is closely tied to the topics chosen for your final papers. The results will be presented over the Web in Week 15 with the help of a PowerPoint slideshow.

*Research Papers – 2 for a total of 24 points.* The first paper will provide you with an opportunity to describe the data capture options and challenges for a project of your choice from a list of projects spanning a variety of application domains and the final paper will afford you the opportunity to integrate all that you have learned in the semester for a specific application that I will designate when the guidelines for the final papers are distributed.

### *Requirements*

*Textbooks* – There are two books required for this course. The first book by Campbell can to be purchased from either the USC Bookstore or online outlets such as Amazon (http://www.amazon.com/) and the second book by Warner and Campagna can be purchased from either the USC Bookstore **or Clark Labs (http://www.clarklabs.org/)**. We will need the Campbell book from the first day of class, and the second book by Warner and Campagna very soon thereafter.

- Campbell, James B. 2011. *Introduction to Remote Sensing (Fifth Edition).* New York, The Guilford Press
- Warner, Timothy A. and Campagna, David J. 2009. *Remote Sensing with IDRISI® Taiga: A Beginner's Guide.* Hong Kong, Geocarto International Centre (*NOTE: Even though the*

*book's title says "Remote Sensing with IDRISI Taiga", all the tutorials in this book work well with the new version of IDRISI (IDRISI Selva) we have on our GIST online server.*)

These textbooks will be supplemented with Course Notes and a mixture of readings from academic journals, professional reports and authoritative websites.

*Readings* – Selected papers and reports will be posted to Blackboard under Course Documents

*Technology* – There are several technology requirements:

- Every student must have a computer with a fast Internet connection (DSL at a minimum).
- Every student MUST have a functional webcam for use whenever a presentation or meeting is scheduled.

*Communications* – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via the Blackboard Assessment link. I will also create one Blackboard (BB) discussion forum at the start of the semester and I may create and/or monitor additional BB discussion forums through which we can discuss issues and comments on the course assignments, exercises and project as the need arises. **Please note that I don't closely monitor all posts on discussions forms, so if you are directing a question to me, you should do this by emailing me and don't assume that posting it on the discussion form means that I automatically read it.**

I will send via e-mail through Blackboard any notices that are time sensitive and also post its as an announcement on Blackboard. Please be sure that you read as soon as possible all e-mail sent from Blackboard or from me. Also double check to be sure that mail sent from both the USC blackboard accounts and my private domain (rashed@gsareh.com) does not go into your junk mail!

While I am usually on-line and will probably respond to e-mails from students relatively quickly, I will endeavor to respond to all e-mail within 24 hours of receipt, aiming for no more than 36 hours delay. In the rare case when I expect to be off-line for more than 24 hours, I will post an announcement on the Blackboard site.

Your responsibility: It is each student's responsibility to stay informed about what is going on in our course. In addition to e-mail about time-sensitive topics, any important announcements will be posted on the Announcement page in Blackboard. Be sure to check these each time you log onto Blackboard.

*Workload* – This is a four credit, one semester course. Students should expect to spend 10-12 hours per week completing the work in this course.

### *Students with Disabilities*

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to an instructor as early in the semester as possible. DSP is located in STU 301 and is open from 8:30 a.m. to 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

### *Statement on Academic Integrity*

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://web-app.usc.edu/scampus/wp-content/uploads/2009/08/appendix_a.pdf . Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

### *Important Administrative Dates*

1/13: Fall semester classes begin
1/20: Martin Luther King's Birthday, university holiday
1/31: Last day to drop a class and receive a 100% refund
1/31: Last day to change enrollment option to Pass/No Pass or Audit
2/17: Presidents' Day, university holiday
3/17-22: Spring Break
4/11: Last day to drop a class with a mark of W
5/2: Spring semester classes end
5/14: Final Examinations end

***Tentative Schedule***

| Week # | Week Begins | Theme | Week's Readings and Practice | | Assignments | |
|---|---|---|---|---|---|---|
| | | | Main Readings | IDRISI Exercises | Reading Assignments (Due **Thursday** of the following week) | Exercises & Papers (Due Week shown) |
| 1 | 1/13 | Remote Sensing Principles | Campbell 1,2 | | | |
| 2 | 1/20 | Image acquisition – Passive Sensors | Campbell 3,4,5,6 | W&C 1 | 1 | |
| 3 | 1/27 | Image acquisition – Active Sensors | Campbell 7,8,9 | W&C 2 | 2 | |
| 4 | 2/3 | Image resolution | Campbell 10 | W&C 3 | 3 | |
| 5 | 2/10 | | | | | |
| 6 | 2/17 | Analysis – preprocessing | Campbel 11 | W&C 4 | 4 | Exercise 1 (Due) |
| 7 | 2/24 | Image classification | Campbell 12 | W&C 5 | 5 | |
| 8 | 3/3 | | | W&C 6 | | |
| 9 | 3/10 | Field data & Accuracy Assessment | Campbell 13 & 14 | W&C 7 | 6 | Paper 1 (Due) |
| 10 | 3/17 | Spring BREAK | | | | |
| 11 | 3/24 | Hyperspectral Remote Sensing | Campbell 15 | W&C 8 | 7 | Exercise 2 (Due) |
| 12 | 3/31 | Integrated Remote Sensing and GIS | Course notes | W&C 9 | 8 | |
| 13 | 4/7 | | | | | |
| 14 | 4/14 | Gallery of Applications | Campbell 17,18, 19, 20, 21 | | 9 | Exercise 3 (Due) |
| 15 | 4/21 | | | | | Presentation |
| 16 | 4/28 | | | | | Paper 2 (Due) |
| | 5/14 | End of semester | | | | |